

In the Specification:

[00007] The development of luminescent substances concentrates on two classes of substances. The one is luminescent molecules, the most common of these being Fluorescein, Rhodamin, Phycoerythrin, Coumarin, [[Cy3]] CY3[®], [[Cy5]] CY5[®], TAMRA, ROX, OREGON GREEN[®], Ethidiumbromid, TEXAS RED[®] and Dabcyl. The other family of compounds are the semiconductor nanocrystals obtained primarily from Groups IIB and VIA, IIIA and VA or IVA of the periodic system, the most common of these being CdS, CdSe, CdTe, ZnS and ZnSe. A particular feature of these semiconductor nanocrystals is the high quantum efficiency and the fact that unlike conventional luminescence dyes they do not tend to fade. A further remarkable point that has made the compounds referred to in literature as "quantum dots" an interesting alternative to conventional fluorescent dyes, is the fact that the absorption and emissions behavior of the quantum dots depends on their size. In concrete terms this means that with smaller particle sizes the emission spectrum shifts towards the short-wave range and vice versa.

[000067] In order to couple the luminescence particles to the corresponding biomolecules such as proteins, antibodies, peptides, enzymes, nucleic acids, oligosaccharides, streptavidin, all of which act as target substances, receptors, bioligands or analyte sensors, the generally known activation and coupling methods for silica gel and/or silanised carriers are used. These include reactions with functional alkoxy silanes that have, for example, amino, epoxy, mercapto, isothiocyanate, acrylic or halogen groups. Examples of such activation and coupling agents include: 3-aminopropyl-

triethoxysilane, 3-aminopropyltrimethoxysilane, 3-glycidyloxypropyltrimethoxysilane, 3-glycidyloxypropylmethyl diethoxysilane, 3-mercaptopropyl trimethoxysilane, 3-isothiocyanatopropyl triethoxysilane, methacryloxypropyl triethoxysilane, chloropropyl triethoxysilane. The introduction of carboxyl, hydroxyl or aldehyde groups via a corresponding derivation of the aforementioned alkoxysilanes, e.g. with amino carboxylic acids, glutardialdehyde or hydrolysis of the epoxy groups with acids or bases to hydroxy derivatives is also generally known from the state of the art. Similarly, the reaction of the epoxy-activated carriers with carboxylic acids, sulphites, thiosulphates, amino-substituted carboxylic acids such as, for example, nitrilo-triacetic acid or imino-diacetic acid according to the known methods also leads to a metal chelate carrier. Activation of the silica gel particles through photoactive agents, for example those carrying arylazide or diazirin functions, that are initially coupled to the carrier by UV irradiation and can then react with the bioligands and/or biomolecules, is also easy to perform. Substances of this type include: N-hydroxysuccinimidyl-4-acidobenzoate, [2-nitro-4-[3-(trifluoromethyl)-3H-diazirine-3-yl]phenoxy]acetyl-N-hydroxysuccinimide, N-hydroxysuccinimidyl-(4-acidophenyl)-1,3'-dithiopropionate, N-[m-[3-(trifluoromethyl)diazirine-3-yl]phenyl]-4-maleimidobutyramide.

[000071] 5 ml of tetramethoxysilane are exposed to ultrasound in an ultrasonic bath together with 2 ml of 0.05 M HCl for 10 minutes at room temperature. 2 ml of the clear sol that is obtained are mixed with 1 ml of a 0.05 % Rhodamin B-solution. This mixture is then added to 25 ml of hexane containing 0.4 ml ~~Korantin~~ KORANTIN® (BASF). The

formulation is dispersed with a dispersing machine (~~Ultra-Turrax~~ ULTRA-TURRAX®) for 3 seconds at 20,000 rpm. After adding 1 ml of a 1% ammonia solution it is dispersed for a further 5 seconds. After a further 5 minutes the particles are precipitated by means of a two-minute centrifugation. The excess is decanted off and rinsed three times with ethanol, acetone and water, approx. 10 ml in each case. Luminescence particles with a particle size of 1-3 μm are obtained.

[000075] 2 ml of the silica sol that has been produced analogous to Example 1 is mixed with 10 mg of CdS-semiconductor nanocrystals, with a mean particle size of 138 nm, that have been synthesized according to a specification from Sooklal et al. (Adv. Mater., Vol. 10, 1083, 1998), and then exposed to ultrasound for 2 min. at room temperature. The mixture is dispersed at 20,000 rpm for 5 seconds in 25 ml of toluene containing 2.5% by volume of dissolved Span 60 and 0.5% by volume of dissolved [[Tween]] TWEEN® 80, with the aid of an ~~Ultra-Turrax~~ ULTRA-TURRAX®. After adding 1 ml of a 6% ammonia solution it is then dispersed for a further 5 seconds. The particles are then separated and prepared analogous to Example 1. Luminescence particles with a mean particle size of 3.6 μm are obtained with an emission maximum of 510 nm.

[000077] 0.5 ml of tetraethoxysilane are mixed with 0.1 ml of water and 0.08 ml of 0.1 M HCl and exposed to ultrasound for 10 minutes at room temperature in an ultrasonic bath. 0.2 ml of the sol that is obtained are mixed with 5 mg (YYbEr)₂O₂S, which has been produced in accordance with a specification from Hampl et al. (Anal. Biochem., Vol.

288, 176, 2001), and treated for 5 minutes in an ultrasonic bath. 30 mg of magnetite powder (~~Bayferrox~~ BAYFERROX[®] 318M, [[Bayer]] BAYER[®], FRG) are then added to the mixture. The mixture is exposed to ultrasound for a further 2 minutes. The mixture is then dispersed by stirring (~~Ultra-Turrax~~ ULTRA-TURRAX[®]) at 12,000 rpm in 3 ml of trichloroethylene in which 2% by volume of ~~Dehymuls~~ DEHYMULS[®] HRE7[®] and 0.5% by volume of ~~Prisorine~~ PRISORINE[®] 3700[®] have been dissolved. 0.08 ml of a 6% aqueous ammonia solution are added during dispersion. The mixture is stirred for a further 5 seconds. Separation and preparation of the luminescence particles obtained is analogous to Example 1.